REMARKS

As noted previously, the Applicants appreciate the Examiner's thorough examination of the subject application.

Claims 1-11 and 21-30 are pending in the application and were rejected in the final Office Action mailed 20 September 2007 on various statutory grounds, described in further detail below. Claims 12-20 and 31-53 have been canceled. Claims 1-11 and 21-30 are listed as previously presented in Applicant's prior paper.

Applicants request reconsideration and further examination of the subject application in light of the foregoing amendments and the following remarks.

Claim Rejections – 35 U.S.C. § 103

Claims 1-8, and 21-26

Concerning item 2 of the Office Action, claims 1-8, and 21-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,565,038 to Ashley ("Ashley") in view of U.S. Patent Publication No. U.S. 2004/0244837 to Nawata et al. ("Nawata"). Applicants respectfully traverse the rejection and request reconsideration for the following reasons and in light of the following synopses of the cited art.

(a) Claimed Systems

Claim 1 (representative of the independent claims under rejection) recites the following:

> 1. A system for delivering a desired mass of gas, comprising:
> a chamber;
> a first valve controlling gas flow into the chamber;
> a second valve controlling gas flow out of the chamber;
> a pressure transducer providing measurements of pressure within the chamber;
> a controller connected to the valves and the pressure transducer, wherein the controller is configured and arranged to

(i) receive a desired mass flow setpoint from an input device;
(ii) close the second valve;
(iii) open the first valve;
(iv) receive chamber pressure measurements from the pressure transducer;
(v) close the first valve when pressure within the chamber reaches a predetermined level;
(vi) wait a predetermined waiting period to allow the gas inside the chamber to approach a state of equilibrium;
(vii) open the second valve at time = t_0;
(viii) calculate a value of the total mass delivered as the second valve is open and as a function of temperature and pressure within the chamber; and
(ix) close the second valve at time = t* when the calculated value of total mass delivered equals the desired mass flow setpoint.

[Emphasis added]

The system of claim 1 includes a first (inlet) and a second (outlet) valve and a pressure transducer/sensor that are connected to a chamber and to a controller. The controller is configured and arranged to control the operation of the valves so that a precise mass of a gas can be delivered through the second valve.

Of particular note, Applicant's controller continuously monitors pressure and temperature of the gas within the chamber, and calculates the actual mass delivered by Applicant's system while the outlet valve is open and delivering gas, thereafter closing the outlet valve at the precise time that a mass flow set point is reached.

(b) Ashley – U.S. Pat. No. 5,565,038

The Examiner relies on Ashley as the primary reference for the rejection. As a threshold matter Applicant points out that Ashley utilizes a mass flow controller (MFC) of the type that Applicant describes as prior art. See, e.g., paragraph [0004] of the subject application.

Ashley teaches systems and methods for removing accumulated films from processing equipment by utilizing the continuous flow of an interhalogen gas acting as an etchant through a

chamber. The flow, once turned on, is controlled by a thermal mass flow controller of the type discussed in "Applicant's Background of the Disclosure" of the subject application. See, e.g., paragraph [0004]. While the Examiner asserts again that Ashley teaches that its MFC calculates actual mass delivered by the system, Applicant respectfully submits that the Examiner may have misunderstood the Ashley reference.

The MFC taught by Ashley utilized for supplying the interhalogen etchant gas(es) to the gas manifold and chamber of Ashley.

Ashley in fact does not teach that its controller calculates actual mass flow emitted from the system. Ashley describes the operation of its disclosed MFC as follows:

> The etch process is now ready to begin. MFC 4 has a setpoint of zero when valve 3 opens, when immediately thereafter, MFC 4 begins to ramp up and system pressure is increased to the desired pressure of the cleaning process by partially closing the throttle valve 16. In the preferred embodiment, a gas flow rate of 300 SCCM and a pressure of 200 mT is desired which is accomplished by the computer 20 sending a signal to MFC 4 to ramp the flow rate from 0 to 300 SCCM in a minute and the computer 20 sensing the chamber pressure by a signal sent by PS 8 while adjusting throttle valve 16 so that the chamber pressure goes from the baseline evacuation pressure to 200 mT during the same minute. A step-function change in the gas flow rate or pressure could be done, but because of the quartz tube used as the chamber for a polysilicon deposition process, a sudden pressure change could result in severe damage to the chamber 7.
>
> See Ashley, col. 9, lines 1-16.

Moreover, Ashley teaches only that the valve is shut off when a down stream concentration detector detects a specified amount of reaction byproduct:

> Detector 12 is set to sense a product gas, which for a polysilicon deposition system is a silicon-halide gas, and sends a signal to the computer 20 which varies with the concentration of the product gas present at the detector 12. The signal starts at one value prior to detecting any silicon halide, changes as the amount of silicon halide increases, and then returns to the initial level

> once all of the accumulated material has reacted since no more silicon halide is produced. Once the detector 12 signal reaches a predetermined level, the computer 20 determines that little, if any, accumulated film is still present in chamber 7. Computer 20 starts a timer (not shown) to give the desired overetch using a predetermined time. The cleaning portion of the process is completed once the time expires.
>
> (Ashley, col. 9, lines 24-37.)
>
> [Emphasis added]

Consequently, the system of Ashley is structurally and functionally different than the Applicant's claimed systems and methods.

(c) Nawata – U.S. Pat. Pub. No. U.S. 2004/0244837

Nawata is cited as the secondary reference for the rejection. Nawata teaches a pulse shot regulator and pulse shot regulating method. The system and method of Nawata utilize an inlet valve, a volume, an outlet valve, pressure measurement, temperature measurement, and an overall controller. As the Examiner noted, Nawata also teaches use of equations of state to determine flow from a known volume.

The system and method of Nawata, however, measure the volume flow Q of gas exhausted from a cutoff valve based on a difference in pressures within a delivery chamber after the inlet valve is closed, and again after the outlet valve is closed, i.e., at the beginning and end of the delivery process. *See* Nawata, paragraph [0060].

For the Nawata system and method, measurements are made only after a particular gas flow delivery process (or pulse shot) has been completed. *See* Nawata, paragraph [0061]. See, also, Nawata, Abstract:

> A flow controller and a flow controlling method are adapted to be released from conventional restrictions by using a novel type called a pulse shot type. A pulse shot (opening/closing operation of a first cut off valve (12) and, after that, opening/closing operation of a second cutoff valve ((17)) is repeated.

[Emphasis added]

Importantly, if the mass in the gas flow delivered by the Nawata system is insufficient for required purposes, the only recourse is to correct the error by a subsequent delivery process (pulse shot) as the Nawata system does not measure actual mass delivered by the system when the outlet valve is in an open condition.

Thus, the systems and methods of Nawata are not structurally or functionally equivalent to Applicant's claimed systems and methods.

(d) Prima Facie Case of Obviousness not established

For a rejection under the 35 U.S.C. § 103(a), the cited reference(s) must teach or suggest each and every of the limitation in the claim(s) at issue. A further requirement for a rejection under 35 U.S.C. § 103(a) is that proper motivation must exist to modify the cited reference(s) in the proposed manner.

In this situation, the combination of Ashley and Nawata fails to teach or suggest each and every limitation in claims 1-8, and 21-26 as amended; further, there is no motivation to modify the teachings of the references in the way proposed by the Examiner. Thus, a *prima facie* case of obviousness for a rejection under 35 U.S.C. § 103(a) has not been established.

For the rejection, the Examiner characterized Ashley as teaching, inter alia:

> a controller (20; Figure 1; column 8, lines 17-67) connected to the valves and the pressure transducer ("PS8"; Figure 1; column 8, lines 17-27) wherein the controller (20; Figure 1; column 8, lines 17-67) is configured and arranged to, receive a desired mass flow setpoint (column 9; lines 1-20) from an input device (20; Figure 1; column 8, lines 17-67 = compare to applicant's specification [0031]), close the second valve (13/14; Figure 1; column 8, lines 1-16); open the first valve (4; Figure 1; column 8, lines 1-16); receive chamber (7; Figure 1; column 8, lines 17-27) pressure measurements from the pressure transducer ("PS8"; Figure 1; column 8, lines 17-27); close the first valve (4; Figure 1; column 8, lines 1-16) when pressure within the chamber (7; Figure

> 1; column 8, lines 17-27) reaches a predetermined level; wait a predetermined waiting period to allow the gas (1; Figure) inside the chamber (7; Figure 1; column 8, lines 17-27) to approach a state of equilibrium; open the second valve (13/14; Figure 1; column 8, lines 1-16) at time = t_0; calculate a value of the total mass delivered as the second valve (13/14; Figure 1; column 8, lines 1-16) is open and as a function of temperature and pressure within the chamber; and close the second valve (13/14; Figure 1; column 8, lines 1-16) at time = t* when the calculated value of total mass delivered equals the desired mass flow setpoint (column 9; lines 1-20) – claim 1.
>
> [Emphasis added]

Applicants respectfully traverse this characterization of Ashley as there is no description or suggestion in Ashley of all of the limitations as arranged in claims 1 and 21 of the subject application, e.g., as claimed in Applicants' claim 1.

The portion of Ashley cited by the Examiner (as allegedly teaching a setpoint and closing the second valve at time = t* when the calculated value of total mass delivered equals the desired mass flow setpoint) actually does not teach what the Examiner contends. To the contrary, the computer taught by Ashley begins an overetch timer and then begins a ramp down process to reduce flow rate from a mass flow controller only after the concentration detector (12) has sent a signal corresponding to a predetermined level of product gas downstream of the chamber. *See* Ashley, Fig. 1 and col. 9, lines 32-40. The closing of the MFC of Ashley is based on signals received from the detector, which is set to a detect byproduct gas. Ashley fails to teach or suggest a calculation of actual mass flowing through the system based on a pressure signal from a pressure sensor and a temperature value, in stark distinction with Applicants' claims.

Thus, Ashley does not teach (or suggest) a system that calculates mass being delivered from the system and closing an output (or second) valve of the system based on the calculated amount of mass delivered by the system, in distinction with the independent claims in the subject application, claims 1 and 21. These deficiencies f Ashley are not remedied by the secondary reference, Nawata, as is explained below.

As described previously, Nawata teaches measurements are made only after a particular gas flow delivery process (or pulse shot) has been completed. *See, e.g.,* Nawata, paragraph [0061].

The Applicants' claimed systems operate in a fundamentally different manner than the system of Nawata by calculating and thereby measuring the mass of gas as it is delivered from the chamber through the outlet valve. A controller of Applicant's claimed system closes the outlet valve at the time the controller determines, by calculation, that the desired amount of mass of gas has been delivered. A control signal is then sent to close the outlet valve.

The Applicants' systems consequently provide advantages over prior art techniques by automatically compensate for varying charge pressures, downstream pressures (which affect flow out of the delivery chamber), and orifice geometries and timing characteristics of the inlet and outlet valves, while still delivering a desired quantity of gaseous mass.

Not only does the combination of Ashley and Nawata not teach or suggest all of the elements of independent claims 1 and 21, as described above, but proper motivation does not exist to modify the references in the way suggested by the Examiner.

In making the rejection, the Examiner stated that one of skill in the art would find it obvious to optimize the operation of Ashley's as taught by Nawata. Applicants traverse this statement and respectfully submit that the Examiner may have employed hindsight analysis, to an impermissible extent, for the rejection. Moreover, one skilled in the art would appreciate both Ashley and Nawata as teaching away from claims 1and 21 (from which the remaining claims under rejection depend).

As noted previously, the operation of the systems and methods of Ashley are based on a mass flow controller permitting flow of an interhalogen gas through the system to etch away films accumulated during normal operation of the system. A central point of Ashley is that the Ashley MFC is to continue to supply the etchant interhalogen gas to the system until the targeted accumulated films have been cleaned (etched) from the system. The way this is accomplished, Ashley teaches, is by the use of a gas detector. The gas detector is placed downstream of the gas

manifold and chamber, i.e., outside of the regular processing equipment.

In doing so, Ashley teaches that the mass flow controller is (i) kept open long enough for the interhalogen gas(es) to remove the targeted films, and (ii) caused to close automatically, upon receiving a signal from a downstream concentration sensor. Thus, Ashley does not teach using pressure and temperature measurements to calculate a desired mass and closing an output/second valve at a calculated time. Because of this shortcoming actually teaches away from the limitations as recited in independent claims 1 and 21 of the subject application.

The Nawata reference also teaches away from the systems of claims 1 and 21 by teaching that all mass calculations for mass delivery by "pulse shots" are performed only after the second cutoff valve has closed and after the mass from the "gas filling capacity" has exited (been exhausted from) the Nawata system. Thus, Nawata calculates mass delivered after its outlet valve has been closed, in marked contrast with the Applicant's claimed systems and methods.

As Nawata teaches that its point of novelty is the "pulse shot," Nawata teaches away from a controller calculating the exiting mass of gas while the outlet (second) valve is open as is recited in Applicant's claims, e.g., claim 1. Thus, one of skill in the art would not find any motivation to utilize a controller as claimed in claims 1 and 21 of the subject application.

Because of the foregoing reasons, the combination of Ashley and Nawata is an improper basis for a rejection of claims 1-8, and 21-26 under 35 U.S.C. § 103(a), and the rejection of claims 1-8, and 21-26 under 35 U.S.C. § 103(a) should be removed accordingly.

Claims 1-10, 21-26, and 30

Concerning item 3 of the Office Action, claims 1-10, 21-26, and 30 were rejected under 35 U.S.C. § 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over Nawata, previously cited. Applicants respectfully traverse the rejection and request reconsideration for the following reasons.

For the rejection, when referring to claim 1, the Examiner contends that Nawata teaches a controller that is programmed to, among other things "open the second valve at time $t=t_0$; and close the second valve at time t* when the mass of gas ("from process gas source"; Figure 1) discharged equals the desired mass."

Applicants respectfully submit that this characterization of Nawata is inaccurate and that Nawata does not teach or suggest (or provide motivation for) all of the limitations of claim 1 (set forth above) and/or claim 21.

While correctly noting that "Nawata is not specific in teaching the operation of his valves with respect to the computer logic and processing claimed in claims 1-8, and 21-29," the Examiner buttressed the rejection by stating "In the event that Nawata is not deemed to anticipate Applicant's claimed inventions, it would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the operation of the claimed apparatus."

As stated previously, Nawata does not teach or suggest a controller that is configured and arranged as recited in independent claims 1 and 21, and therefore does not anticipate independent claims 1 and 21 or for that matter any claims dependent upon claims 1 and 21. Further, was as stated previously, Nawata actually fails to suggest and indeed teaches away from the elements of claims 1 and 21 by teaching that a pulse shot is completed prior to any calculations for mass delivered.

Thus, Nawata is an improper basis for a rejection of claims 1-10, 21-26, and 30 under 35 U.S.C. § 102(e)/§103(a), and these claims are patentable over Nawata. The rejection of claims 1-10, 21-26, and 30 under 35 U.S.C. § 102(b)/§103(a) should be withdrawn accordingly and the claims allowed.

Claims 11 and 27-29

Concerning item 4 of the Office Action, claims 11 and 27-29 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Nawata in view of U.S. Patent No. 6,193,212 to Ohmi et al.

("Ohmi"). Applicants respectfully traverse the rejection and request reconsideration for the following reasons.

The deficiencies of Nawata relative to claims 1 and 21 (from which claims 11 and 27-29 depend, respectively) are described above. For the rejection, the Examiner correctly noted that Nawata fails to teach or suggest that the second valve has a response time of about 1 to 5 milliseconds, and then cited Ohmi as allegedly remedying the deficiency of Nawata concerning the teaching of a response time of about 1 to about 5 milliseconds. Without acceding to the accuracy or correctness of the Examiner's characterization of the teachings of Ohmi, the reference fails to remedy the previously described deficiencies of Nawata relative to claims 1 and 21, respectively, the base claims for claims 11 and 27-29. Claims 11 and 27-29 are therefore patentable.

In contrast with Applicants' claims, Ohmi describes a fluid control valve and fluid supply/exhaust system. The control valve is described as having a response time in the order of several milliseconds, as cited by the Examiner. The Ohmi reference teaches generally that its fluid control valve is "electrically controlled." See, Ohmi, col. 10, lines 20-23. One embodiment of Ohmi is described as including a fluid supply and exhaust system used with a control computer and a unit control apparatus. See, e.g., Ohmi, col. 14, lines 38-48 and FIG. 10.

Ohmi describes operation of the referenced system in vague and general terms of "control of the opening and closing of a plurality (maximally approximately 20) of fluid control valves by means of an operation signal S from a control computer 24 provided at a central control point." See Ohmi col. 14, lines 38-48. The remainder of the description of this embodiment addresses concerns of overheating of the related actuation coil and of the creation of shock as result of elastic forces of the related spring. Ohmi does not teach, inter alia, a controller that is configured and arranged to control operation of an outlet valve in response to a control signal from a controller calculating a mass flow (based on a pressure measurement and a temperature) while the outlet valve is open.

Because of the foregoing, one skilled in the art would appreciate that, at the very least, Ohmi

does not teach or suggest the limitations of the controller as recited in claims 1 and 21 of the subject application. Thus, Ohmi does not cure the deficiencies noted previously for Nawata.

Consequently, the combination of Nawata and Ohmi fails to teach or suggest all of the limitations of independent claims 1 and 21, which are therefore patentable over these cited references. As claims 11, and 27-29 depend from claims 1 and 21, respectively, they are patentable for at least the same reasons as claims 1 and 21. Thus, the rejection of claim 11, and 27-29 under 35 U.S.C. § 103(a) is without proper basis and should be withdrawn.

Response to Arguments

In responding to Applicants' previous paper, the Examiner stated:

> [T]he Examiner notes that the "methods" of Ashley's apparatus, and the presently claimed apparatus, are demonstrated to have structural, and this functional equivalence. Thus, when the structure recited in the reference is substantially identical to that of the claims, claimed properties or functions are presumed to be inherent. [Citations omitted]
>
> With respect to Applicant's position that "Ashley operate on a time scale that is greater than that of the claimed systems and methods by orders of magnitude" because "a thermal mass flow controller as taught by Ashley is not capable of measuring a short burst of flow from a quick on/off cycle of a valve", the Examiner notes that a "short burst" is relative term and may, depending on Applicant's description thereof support the structural and functional equivalents in Ashley.

Applicants traverse the Examiner's equating the methods or systems of Ashley with the methods and systems/structures claimed in the subject application. Further, the systems of Ashley are for cleaning prior art atomic layer deposition ("ALD") chambers are contemplated in the Background section of the subject application. See, paragraphs [0003]-[0004] of the specification as filed. As was stated previously, the Ashley system relies on a down-stream detector set to detect a byproduct gas (i.e., a byproduct of applied interhalogen gas and the accumulated films) and based on the detected level, control application by an MFC of the interhalogen etchant gas. Moreover,

Applicants respectfully submit that, as was stated in the previous amendment, the time scale of Ashley is on the order of minutes. See, e.g., Ashley, claims 11 and 12, which recite a predetermined reaction time of no more that five hours and between a quarter minute and one hour , respectively.

Thus, one skilled in the art would understand that Ashley does not teach or suggest Applicant's claims. Moreover, as was explained previously, Ashley does not calculate mass leaving the system based on pressure and temperature nor closing a second valve based on such calculated mass.

In the Response to Arguments section of the Office Action, the Examiner stated further that:

> In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., "Measurements are made only after a particular has flow delivery process (or pulse shot) has been completed) are not recited in the rejected claims. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims.
>
> (Emphasis added) [Citation omitted]

Applicant respectfully points out that the above-cited language from Applicant's last paper is a description of how Nawata disclosure differs from the Applicant's claims, i.e., a statement that Nawata teaches "measurements are made only after a particular has flow delivery process (or pulse shot) has been completed)." Thus, such language is directed to what Nawata teaches and naturally is not relied upon by Applicants in the claims of the subject application. As stated previously, and in contrast with Nawata, Applicants' claims include that mass flow calculations are performed while the outlet valve is open.

Conclusion

In view of the amendments and remarks submitted herein, Applicants respectfully submit that all of the pending claims in the subject application are in condition for allowance, and respectfully request a Notice of Allowance for the application.

Applicants note that a Request for Continued Examination (RCE) under 37 CFR § 1.114 and a Petition for Extension of Time (two months) are submitted with this paper.

If a telephone conference will expedite prosecution of the application, the Examiner is invited to telephone the undersigned.

Authorization is hereby given to charge our deposit account, No. 50-1133, for any fees required for the prosecution of the subject application.

Respectfully submitted,

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